

IMPROVEMENT OF THE DISSOCIATION ENERGY OF THE HYDROGEN MOLECULE (PART ONE)

JOËL HUSSELS, CUNFENG CHENG, MING LI NIU, HENDRICK BETHLEM, K.S.E. EIKEMA, EDCEL JOHN SALUMBIDES, WIM UBACHS, *Department of Physics and Astronomy, VU University, Amsterdam, Netherlands*; MAXIMILIAN BEYER, NICOLAS HOELSCH, JOSEF A. AGNER, FREDERIC MERKT, *Laboratorium für Physikalische Chemie, ETH Zurich, Zurich, Switzerland*; LEI-GANG TAO, SHUI-MING HU, *Hefei National Laboratory for Physical Science at Microscale, University of Science and Technology of China, Hefei, China*; CHRISTIAN JUNGEN, *Laboratoire Aimé Cotton, CNRS, Orsay, France*.

The dissociation energy (D_0) of ortho H_2 is a benchmark value in quantum chemistry, with recent QED calculations now approaching accuracies achievable in simple atoms. A precision measurement of the GK-X molecular transition, in combination with other precision measurements (see also part two), provides an improved value for D_0 .^[1, 2] The GK-X transition is excited through Doppler-free two-photon spectroscopy using 179-nm radiation, based on frequency up-conversion using a special KBBF crystal. The optical frequency of the fundamental (716 nm), which is the output of a narrowband pulsed Ti:Sa laser system, is locked to a frequency comb. This enables accuracies at the sub-MHz level, leading to an order-of-magnitude improvement for D_0 to the 10^{-9} level of accuracy. The comparison of this accurate experimental result with the best calculations may provide a test of the Standard Model of Physics.^[3]

[1] D. Sprecher, Ch. Jungen, W. Ubachs and F. Merkt, *Faraday Discussions* 150, 51-70 (2011)

[2] W. Ubachs, J.C.J. Koelemeij, K.S.E. Eikema and E.J. Salumbides, *J. Mol. Spectr.* 320, 1-12 (2016)

[3] J. Liu, E. J. Salumbides, U. Hollenstein, J. C. J. Koelemeij, K. S. E. Eikema, W. Ubachs and F. Merkt, *J. Chem. Phys.* 130 (17), 174306 (2009)